In the Drawings:

Applicant has amended the drawings and corrected FIGS. 1-12 to include Cartesian coordinates, as appropriate throughout, to maintain clarity in accordance with 37 CFR §1.121(d). Applicant submits replacement drawings FIGS. 1-12 in accordance with 37 CFR §1.84(c). For the foregoing reasons, Applicant believes that the drawings are in condition for publication and allowance, which is respectfully requested.

Appendix:

Replacement Sheets

Annotated Sheets Showing Changes

REMARKS

Applicant traverses the examiner's recitation of the restriction requirement to the extent that FIG. 6 (side view) and FIG. 9 (end view) are drawn to the same species and there is no distinction between the recited species E and H. Applicant's election of Species E and response to the restriction requirement, which is reproduced below, identified both the side and end[1] views:

> In response to the Office Action mailed August June 24, 2005 requesting restriction, Applicant elects Inventions of Group I, claims 1-12 and 15-16. Applicant further elects the species embodied in FIGS. 6 (side view) & (sic) 10 (end view) directed to claims 1, 6 and 10 readable thereon having a dielectric and/or metamorphic mirror structure.

To this extent, correction of the scope of the restriction of Species E and H, forming Species E as both FIGS. 6 and 9, is respectfully requested.

In the drawings, Cartesian coordinates have been added to address the examiner's objection to the specification in relation to claim 1. Replacement sheets for Figures 1-12 are supplied herewith. For the foregoing reasons, applicant believes the drawings are in condition for allowance and publication, which is respectfully requested.

In the specification, the paragraphs [0009], [0011], [0025], [0028] through [0029], [0032] through [0033], [0037], [0038][2], [0040] and [0042] have been amended for clarity and to correct minor topographical changes to put the specification in

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[1] Applicant corrects a topographical error herein, as Species C and I are the side and end views of FIGS 4 and 10 of a non-elected other embodiment.

[2] Applicant corrects and deletes mis-coded paragraph [0038] in the publication US2004/0032647A1, as the portion related to paragraph [0037], to put the application in condition for publication and allowance.

condition for allowance. For the foregoing reasons, applicant believes the specification is in condition for allowance and publication, which is respectfully requested.

Applicant acknowledges that, with respect to claim 1, the examiner correctly construed the waveguide and active region/optical cavity as part of the same structural element. As a result, claim 1 has been amended to reflect them as the same structural element. Withdrawal of the objection is respectfully requested.

The examiner has objected to Claim 10. Applicant respectfully traverses the objection. The examiner overlooks the fact that the specification of US2004/0032647A1 includes an enabling description of epitaxially grown, metamorphic and semiconductor materials in paragraphs [0032] through [0034], and particular, [0032] includes:

> "Referring to Figure 6, an alternative embodiment of the present invention is illustrated *whereby a semiconductor bottom mirror 40 is disposed on a substrate and the bottom mirror 40 and active areas are epitaxially grown. In this embodiment, however, the top mirror 42 is composed of metamorphic (non-lattice matched) 43 material. Exemplary metamorphic materials include GaAs /AlGaAs grown on a non-lattice matched substrate, such as InP, or other suitable materials.* Alternatively, lattice-matched semiconductor materials can be used to form the cavity and top mirror structure whereby the single crystal nature of the entire structure is maintained. The light to be amplified 52 enters at input 46 and exits at output 48 as amplified light 54, whereby the light beams both enter and exit the device on the top side. According to the embodiment, a ¾-λ cavity 42 containing an active region 50 is disposed adjacent to the bottom mirror 40. Similarly, a ¼-λ metamorphic layer 43 with high refractive index is disposed adjacent the partial cavity 42 forming a 1-λ hybrid cavity. *The metamorphic layer 43 has its interface disposed or placed at a null in the optical field so as to minimize scattering and absorption losses due to defects. Furthermore, additional layers of thickness equal to an integer multiple of ½-λ can be inserted above or below the metamorphic interface without changing the location of the null. A top metamorphic DBR mirror 84 is disposed adjacent to the hybrid cavity 42, which includes the metamorphic layer 43. In the described exemplary embodiment, the bottom mirror 40 is made of InP/InGaAsP while the top mirror 84 is made of a GaAs/AlGaAs.* A top metal contact 88 is used to increase the reflectivity of the top mirror, or to pump current

> through the mirror, or both. The light to be amplified 52 enters at the input 46, propagates longitudinally in a zig-zag fashion through the active region, and the amplified light 54 exits at the output 48. The entry 46 and exit 48 points contain AR layers to provide maximum coupling into and out of the structure. *In a variation on this embodiment, a dielectric material can be substituted for the metamorphic material layer for layer*. However, in this case electrodes would necessarily be placed on the side of the waveguide. *Exemplary dielectric materials include, SiN_x, SiO_2, ZnSe, MgF_2, or other suitable dielectric materials*."

See [0032] US2004/0032647A1 (emphasis added). As is shown in [0032], as amended, applicant discloses both the method and exemplary examples of metamorphic semiconductor materials. For other reasons "epitaxially grown" material is implicitly known in the art insofar as optoelectronic devices, defined as those in which electrons, holes and photons interact, are necessarily comprised of single crystal semiconductor materials so as to minimize non-radiative recombination or generation. All known methods of thin film single crystal growth are collectively referred to as "epitaxy" or "epitaxial growth". For the above-reasons, withdrawal of the objection regarding claim 10 is respectfully requested.

Applicant traverses the rejection to claim 1 over the Carey reference ((US 6,277,696) the "Carey reference" or "Carey") because Carey does not teach, show or suggest all the structural limitations of the claim including input and output portions formed in the mirrors having "layers of reduced reflectivity relative to a corresponding first or second mirror" having a longitudinal waveguide with VCSEL-like elements (DBR mirrors as cladding layers) as set forth in original Claim 1. Carey is directed to a double-fused VCSEL whereby the applicant's invention relates to a semiconductor optical amplifier having a longitudinal waveguide with VCSEL-like elements (DBR mirror). Withdrawal of the rejection is respectfully requested. For the foregoing reason,

applicant believes claims 1, 6 and 10 are distinguished from the prior art in terms of their structure rather than by function, and are in condition for allowance, which is respectfully requested.

All of the claims 1, 6 and 10, have been amended to recite, among other things, "a longitudinal waveguide integral to said optical cavity" having "a downward step in reflectivity at input and output ports." Claim 1 now recites a semiconductor optical amplifier having:

> "a longitudinal waveguide integral to said optical cavity connecting said input and output ports, whereby said longitudinal waveguide is configured with a downward step in reflectivity at input and output ports of the optical amplifier."

The claim amendments are unrelated to patentability over the cited references as is described above. Applicant believes claims 1, 6 and 10 are distinguished in terms of their structure rather than by function, and are in condition for allowance, which is respectfully requested.

The present claims, as amended, avoid the Carey reference because Carey merely describes the presence or absence of said mirror in the lateral direction for the purpose of current confinement in the active region of a double-fused VCSEL. The lateral termination of component #304 in FIG. 3B of the Carey reference represents the presence or absence of said mirror for the purpose of current confinement in the active region, and not for optical mode guiding. In other words, the optical mode present in the Carey device would see a homogeneous mirror, as depicted by component #304 in FIG. 3B. While Carey uses the words "fused" and "different lattice matched" to teach his

structure, the Carey reference mirrors are single crystal (lattice-matched) with a different lattice parameter than the active region, which is also a single crystal. Applicant's invention, conversely, involves growing (depositing) the upper mirror whereby the upper mirror has a different lattice parameter. In fact, the lattice parameter is so different that the material may not be crystalline as deposited. Applicant's invention includes a mirror configured with a downward step in reflectivity at input and output ports of the optical amplifier. Applicant's structure and function is distinguish over Carey and the art of record. Moreover, Applicant's structure and an intended operation is significant in determining patentability of his apparatus claim, and the Examiner's reliance on, and application of, MPEP 2115 (Material or Article Worked Upon by Apparatus) to "articles worked upon are the semiconductor layers" is misplaced because MPEP §2115, clearly prohibits such application, by stating:

> "Note that this line of cases is limited to claims directed to machinery which works upon an article or material in its intended use. It does not apply to product claims or kit claims."

For the foregoing reasons, applicant believes claims 1, 6 and 10 are in condition for allowance, which is respectfully requested.

Additionally, FIG. 3B of Carey is directed to a double-fused VCSEL whereby the applicant's invention relates to a longitudinal waveguide with VCSEL-like elements (DBR mirror). Carey also does not teach a longitudinal waveguide with the same structure, intended operation and in the same orientation as the current invention. In Carey's coordinate system, the vertical dimension of FIGS. 3A and 3B represents his "longitudinal" direction, that is, a direction of light propagation, but such direction

corresponds to applicant's transverse (y) direction, that is, a direction of light confinement. For that matter, Carey does not teach, suggest or disclose a waveguide in a longitudinal direction, either in the specification, or in the claims. Moreover, no suggestion or disclosure is made for optical mode confinement in the lateral (x) direction, as is required for the formation of a longitudinal waveguide, and Carey would be inoperative for such function. The present invention not only provides a semiconductor optical amplifier, it provides an amplifier that includes a longitudinal waveguide integral to said optical cavity having a downward step in reflectivity at input and output ports of the optical amplifier. This is not taught, shown or suggested in Carey or the other art of record.

In view of the above, Applicant believes that the application is in condition for allowance of such embodiments and claims under the above-identified restriction. If Examiner believes that an interview will be helpful in the examination of the patent, in person or by telephone, Applicant would be pleased to arrange and attend. Applicant's attorney should be contacted for any additional information.

Respectfully submitted,
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Appendix

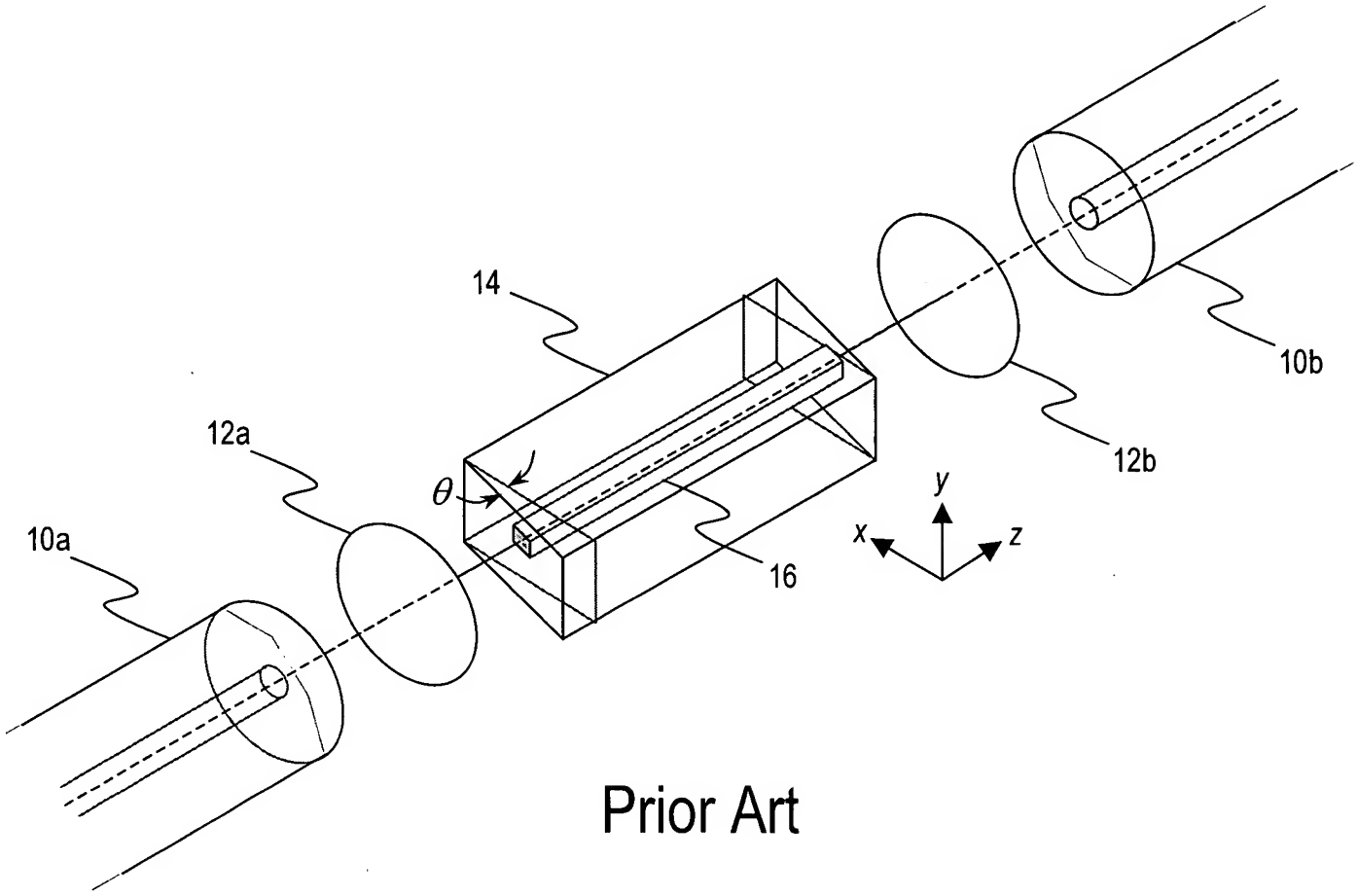
Drawings FIGS. 1-12 (black and white, grey scale)

Drawings FIGS. 1-12 (color)

Drawings FIGS. 1-12 (annotated highlighting changes)

Substitute Specification (clean)

Substitute Specification (mark-up showing edits)



Prior Art

Figure 1

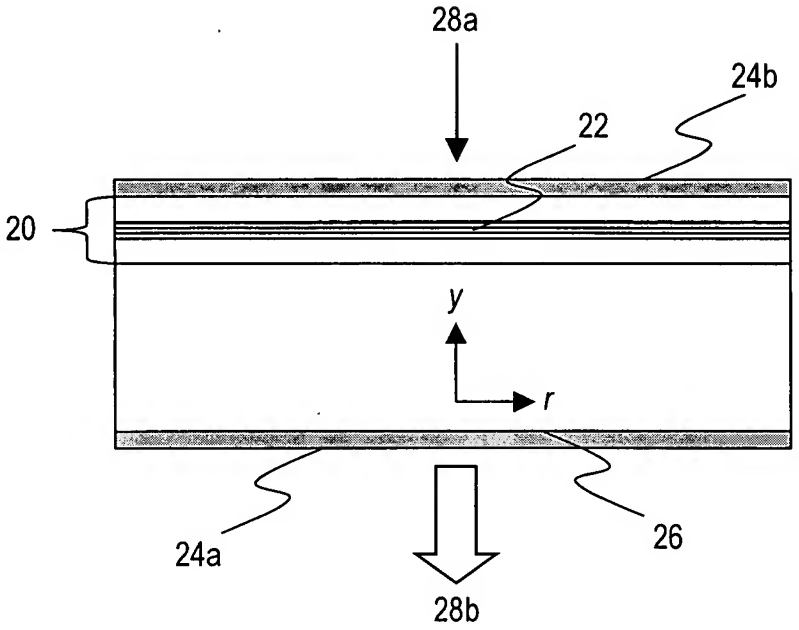


Figure 2

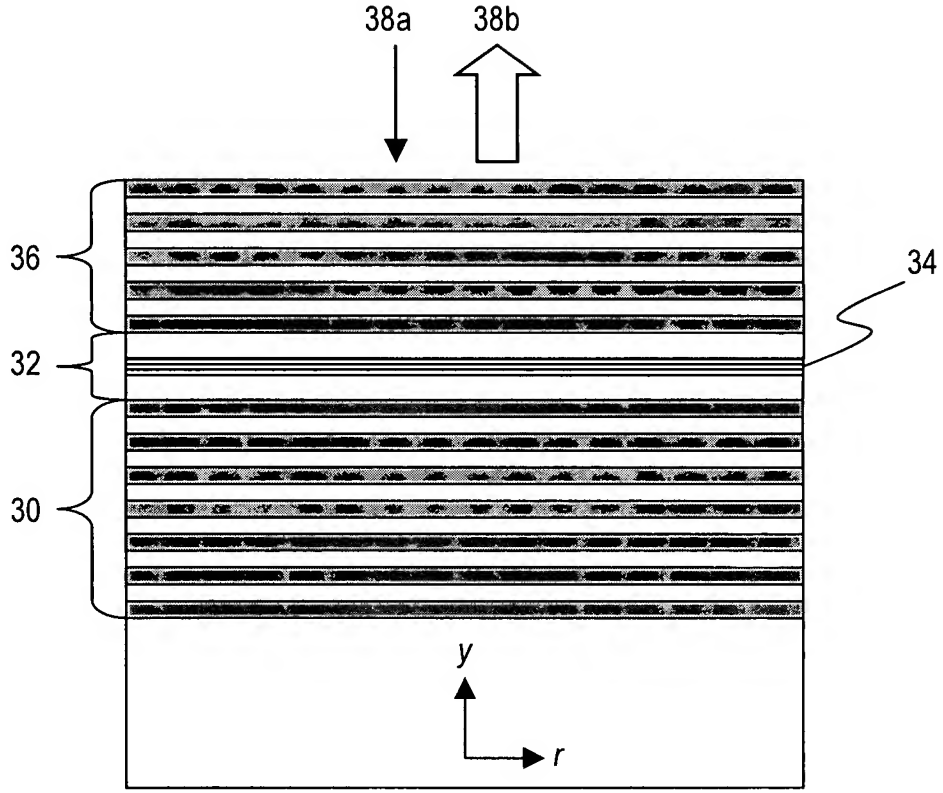


Figure 3

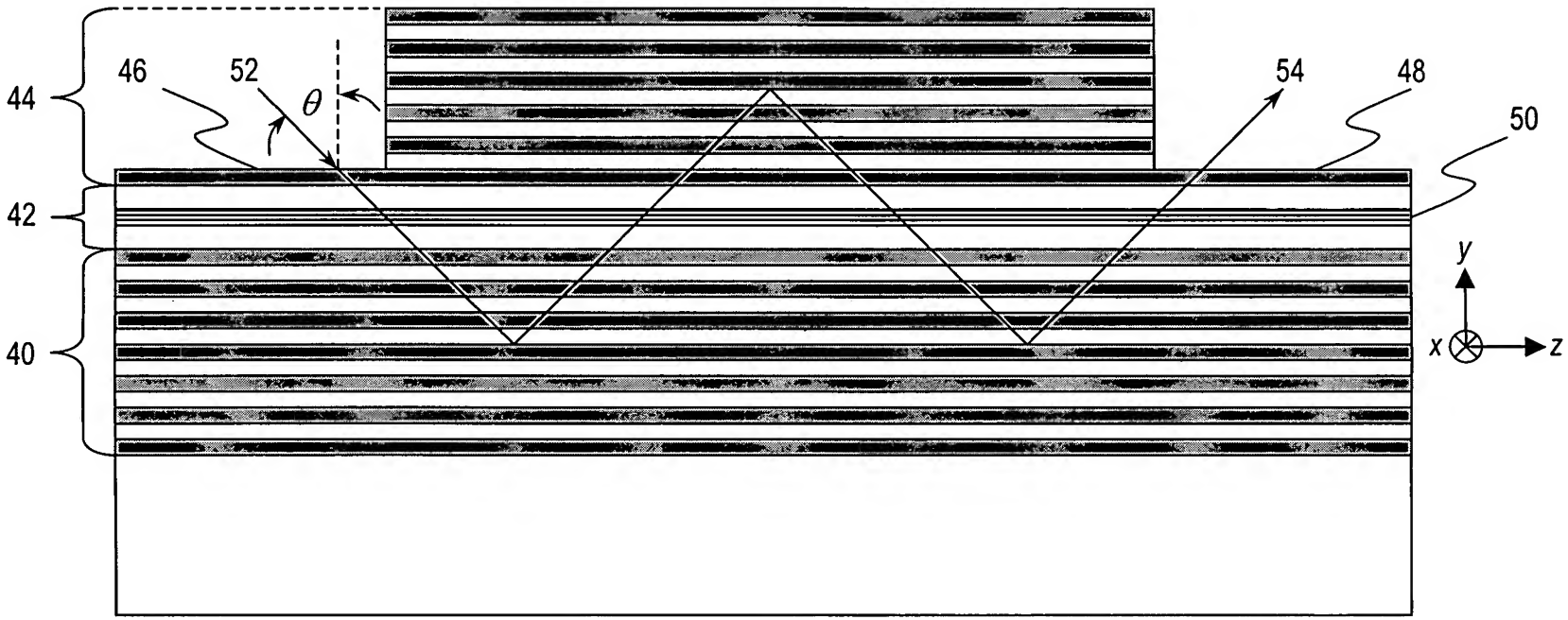


Figure 4

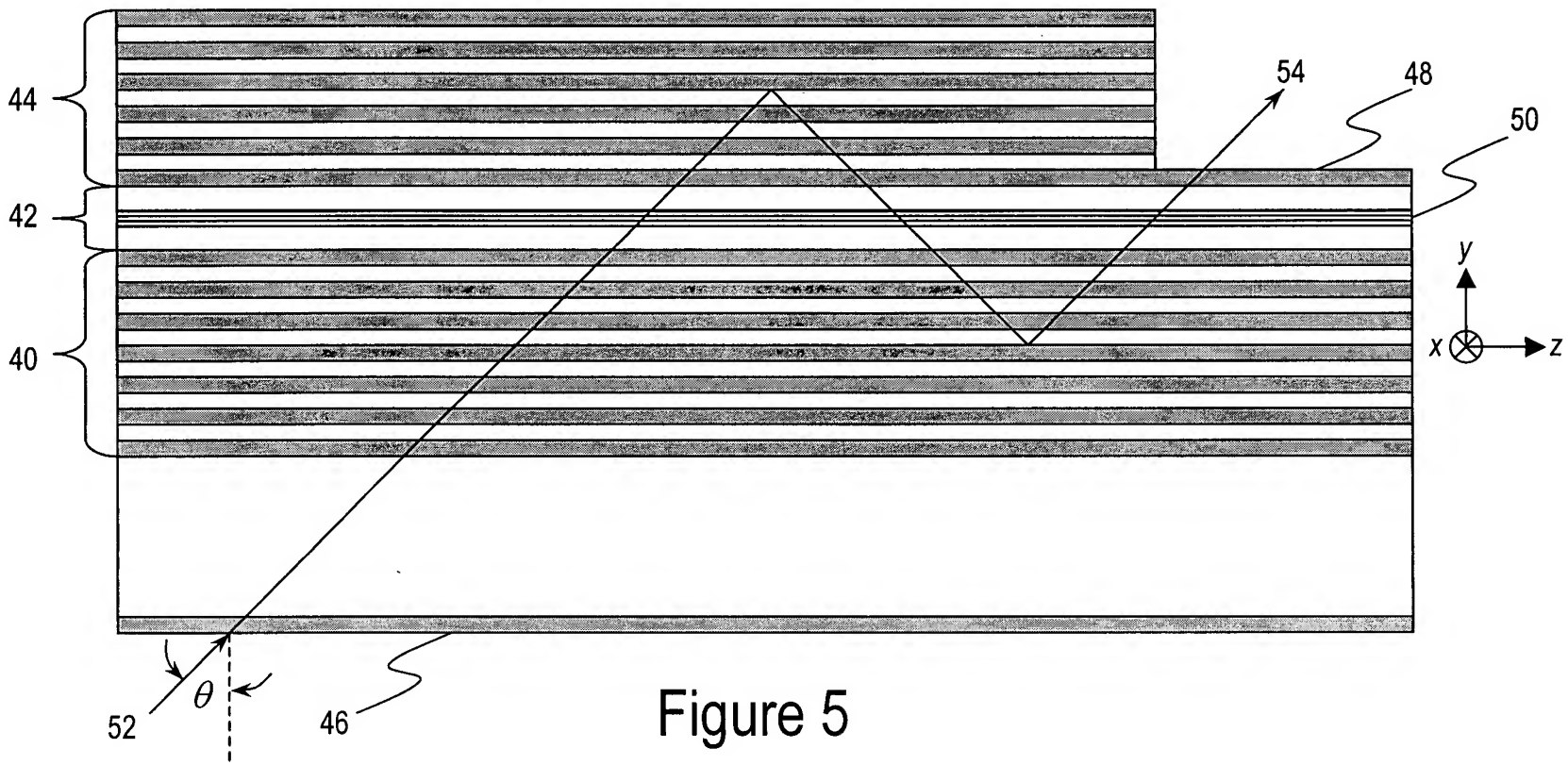


Figure 5

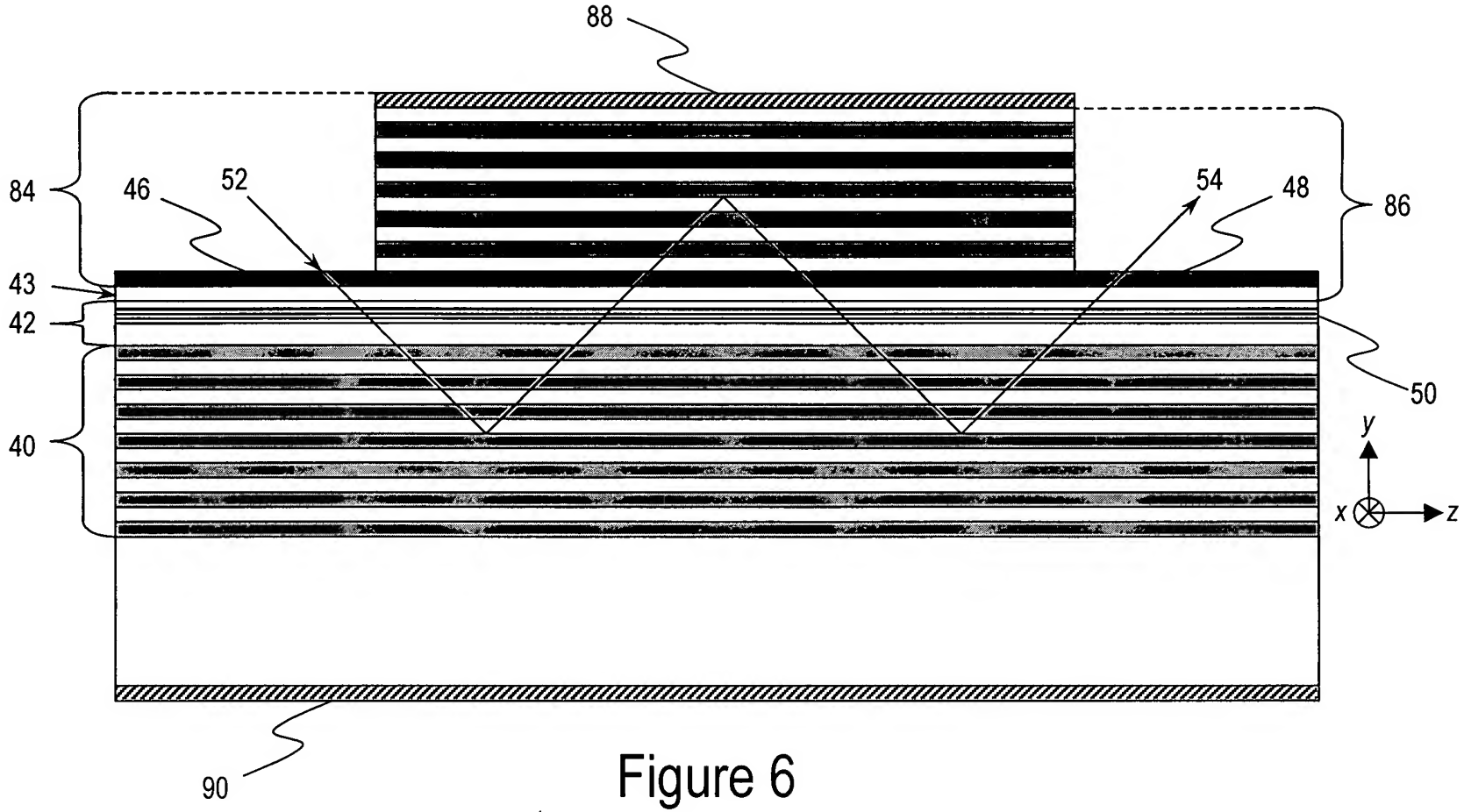


Figure 6

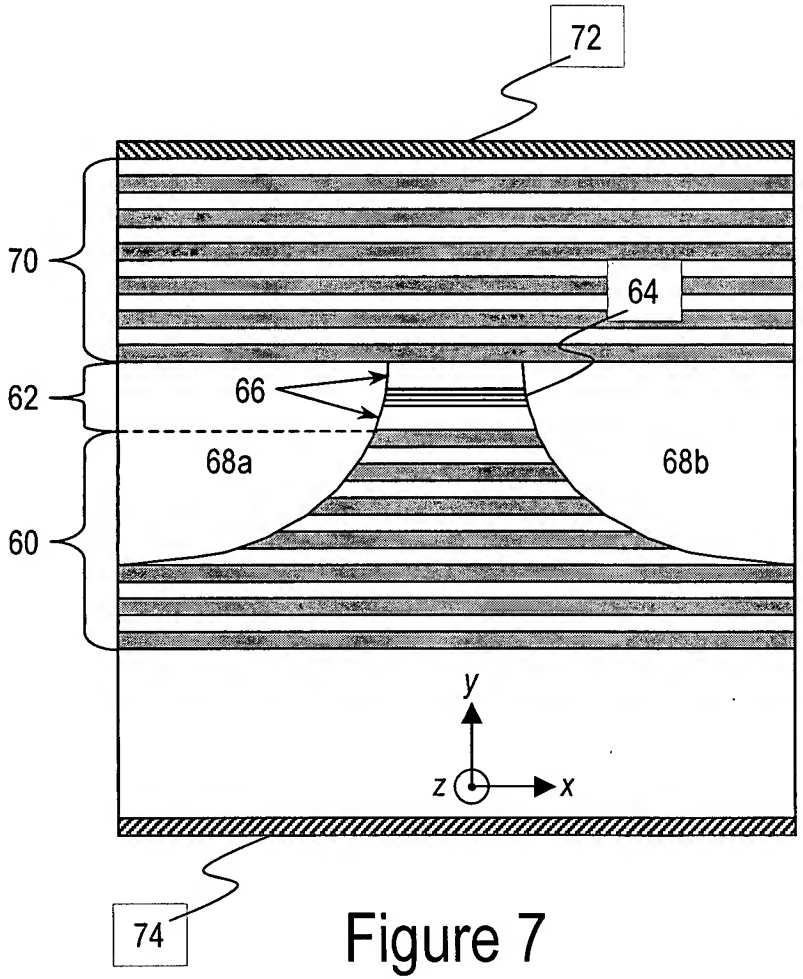


Figure 7

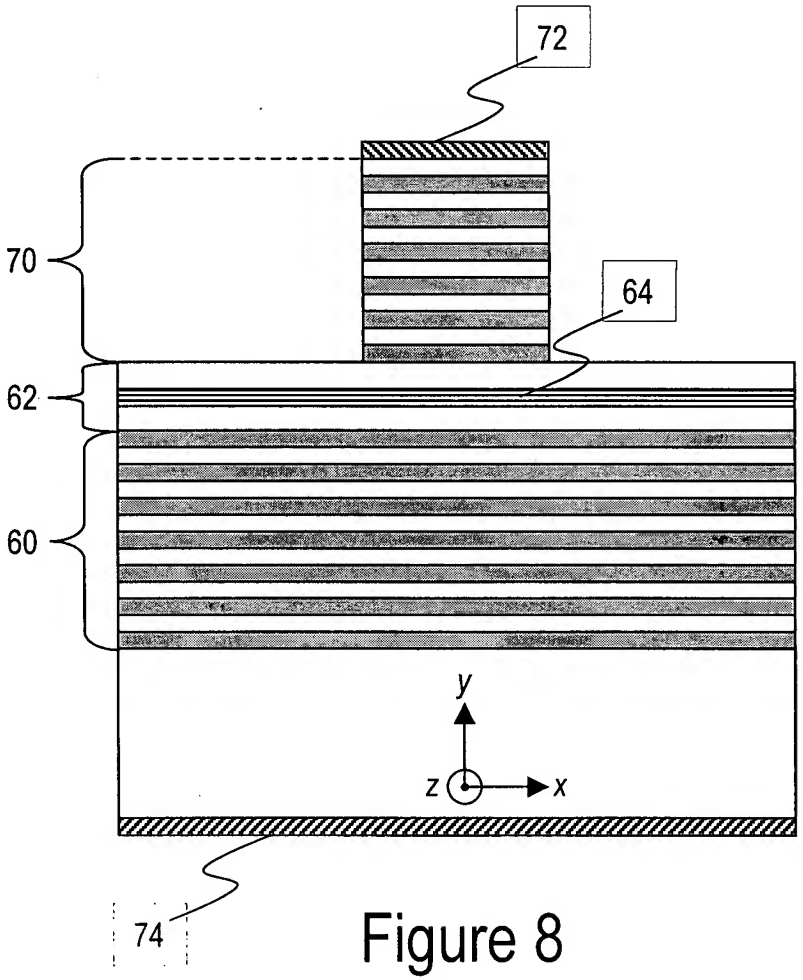


Figure 8

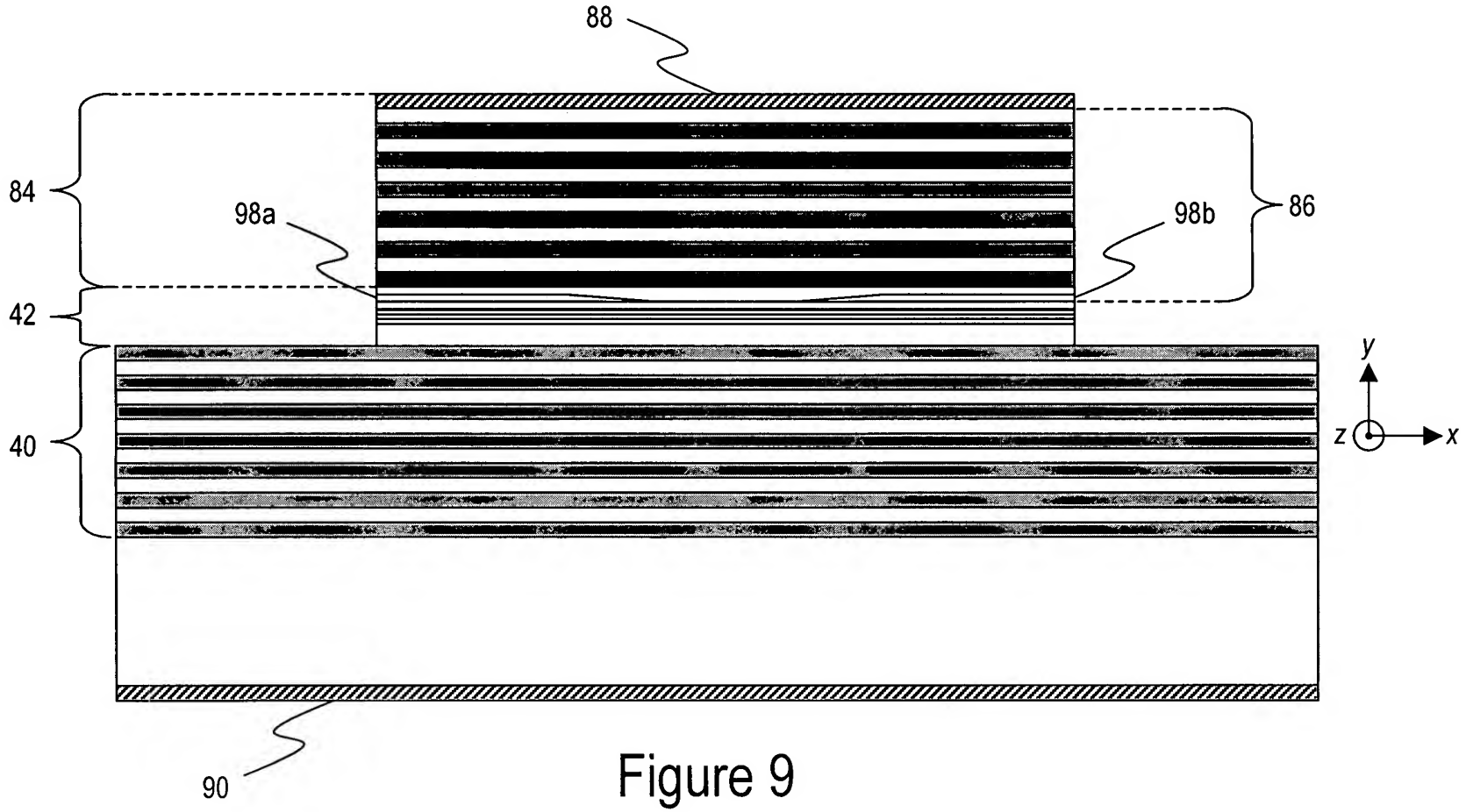


Figure 9

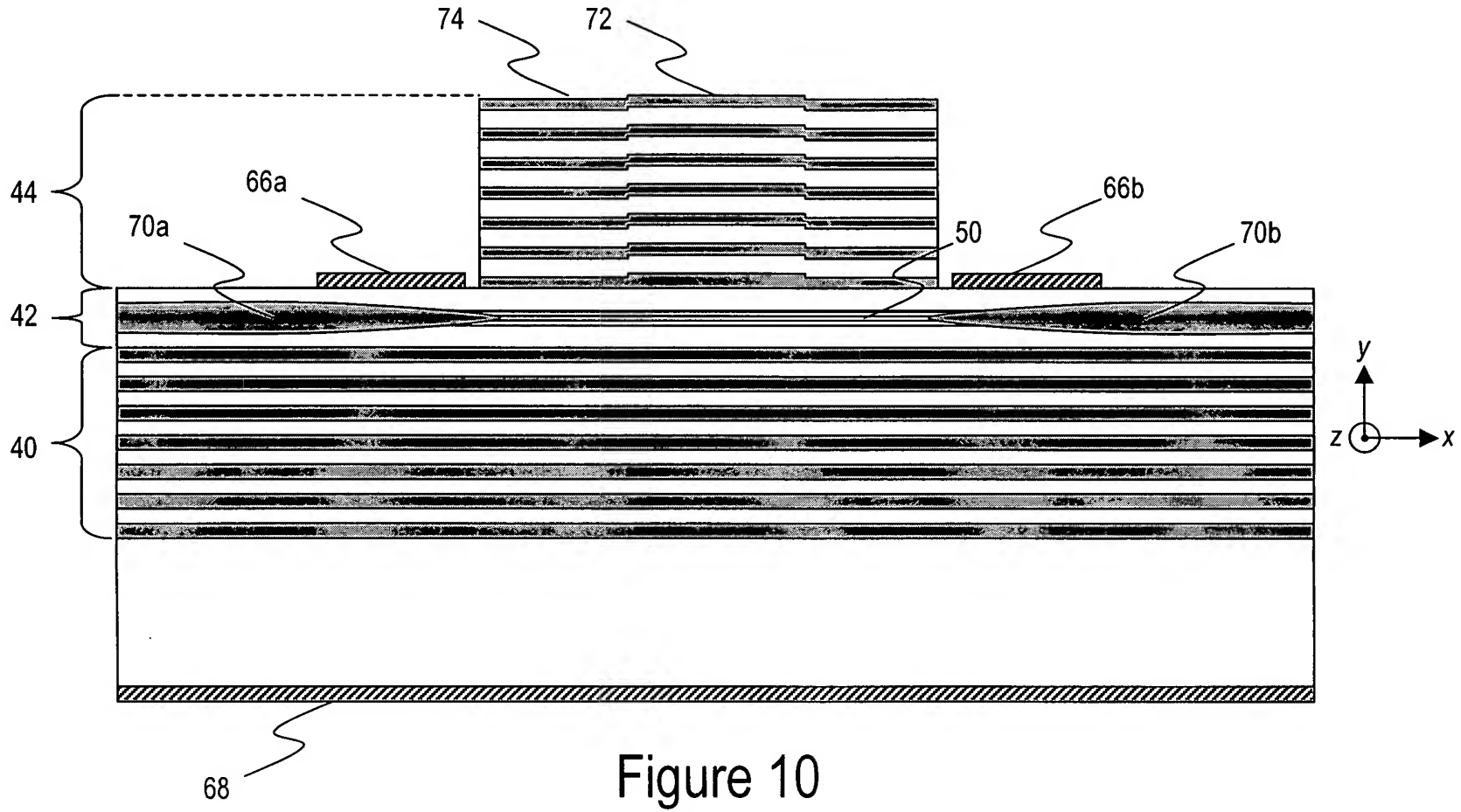


Figure 10

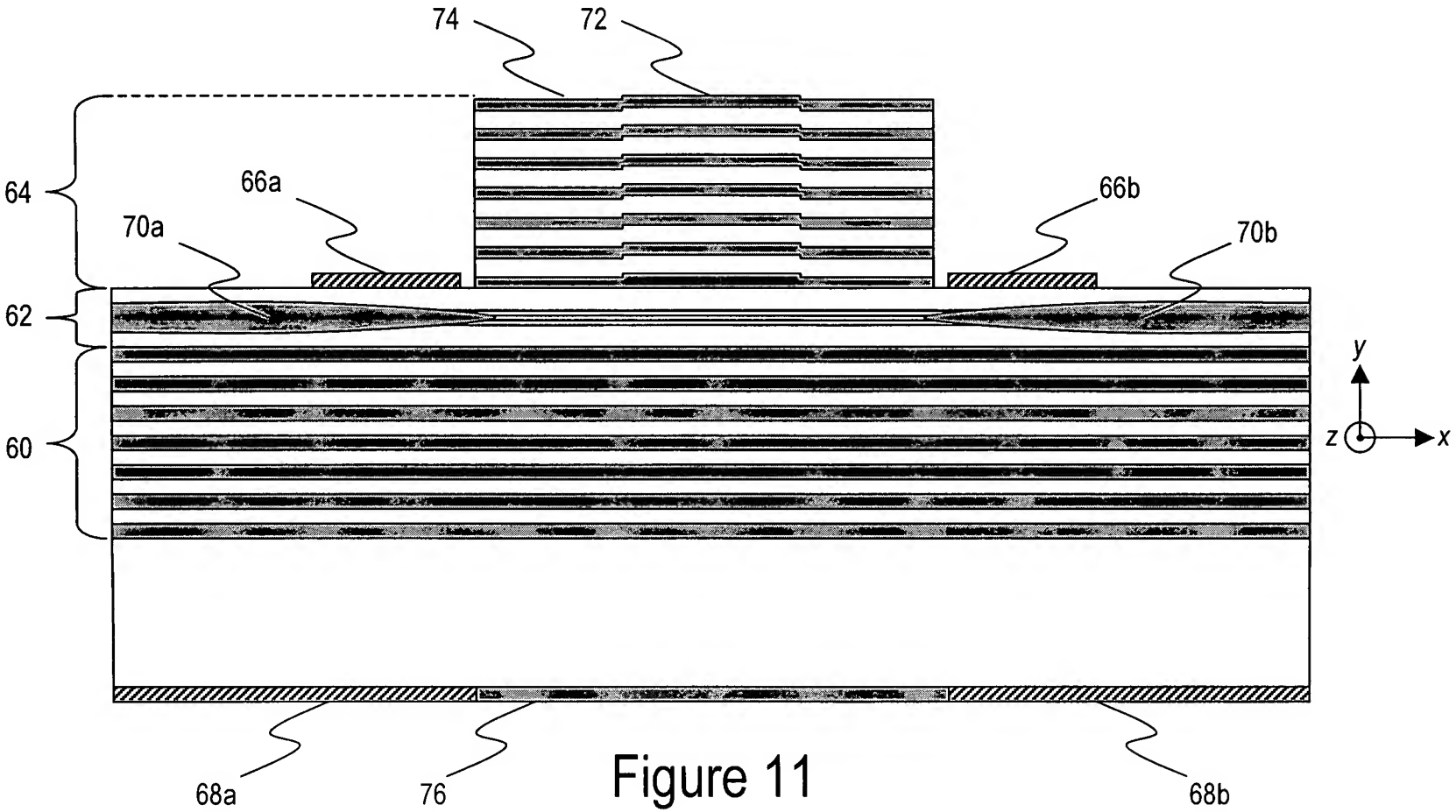


Figure 11

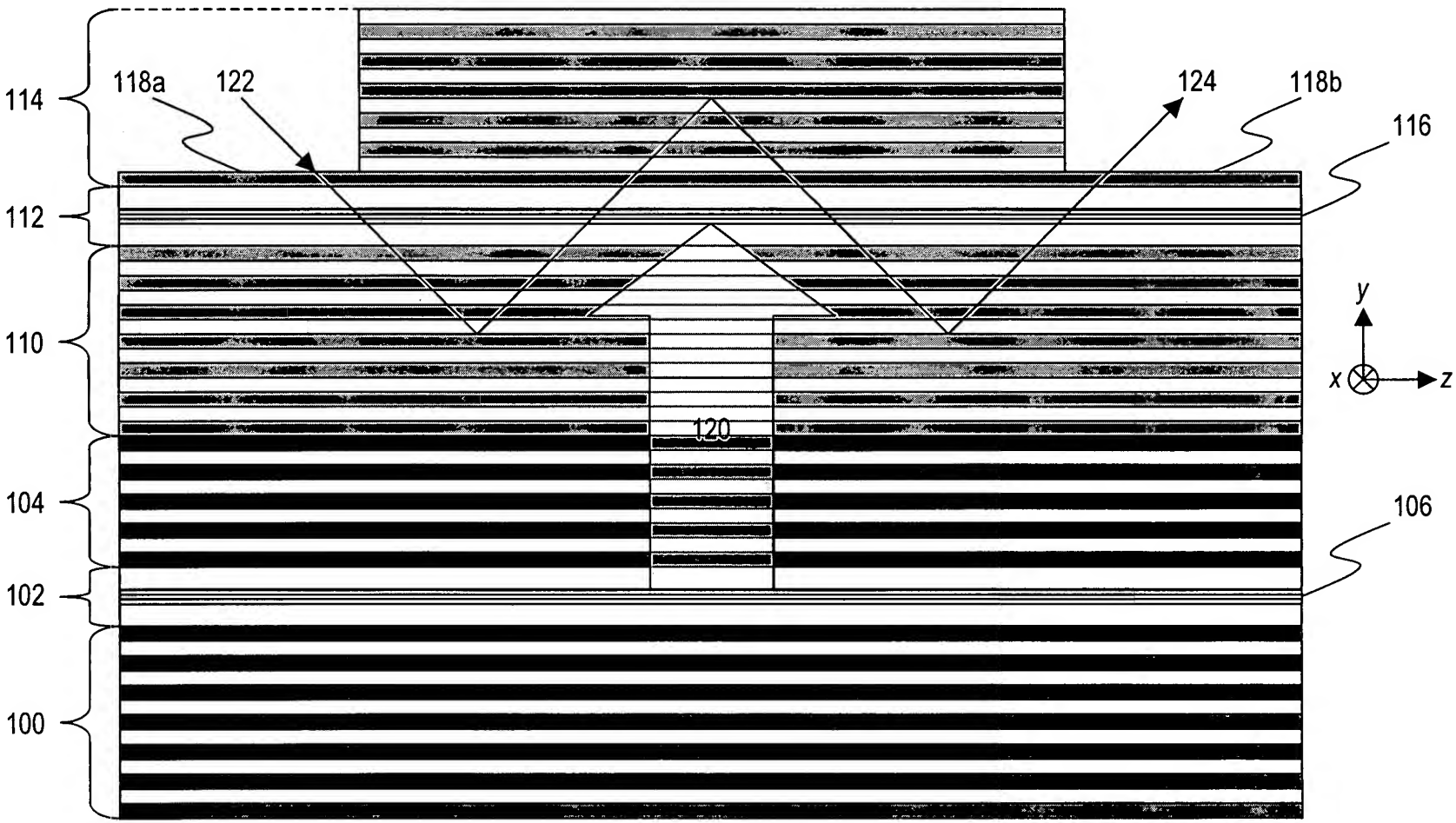


Figure 12